Greenhouse Gas Performances of Waste Management Scenarios

ACR+ International Conference

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Agenda

1. Scope of analysis and objectives
2. Core methodological approach
3. Results from selected scenarios
4. Sensitivity analysis
5. Key conclusions and implications for London

Scope of Analysis and Objectives

- Focus on 'residual' municipal waste management only
  - Evidence base for approaches to source-separation can be drawn from elsewhere

- Clear system boundaries..
  - Emissions from waste collection excluded
  - Emissions from construction of facilities excluded

- Important to be transparent to enable identification of high-performing scenario elements

- To assess 'best of breed' processes
  - Pointless to model those which we know will perform badly

- To rank scenarios according to their GHG performance only
  - Cost, planning, technical feasibility and other environmental issues are not considered

Core Methodological Approach

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Cost-benefit Analysis and Discounting

– Informed by Life-cycle Assessment (LCA) principles

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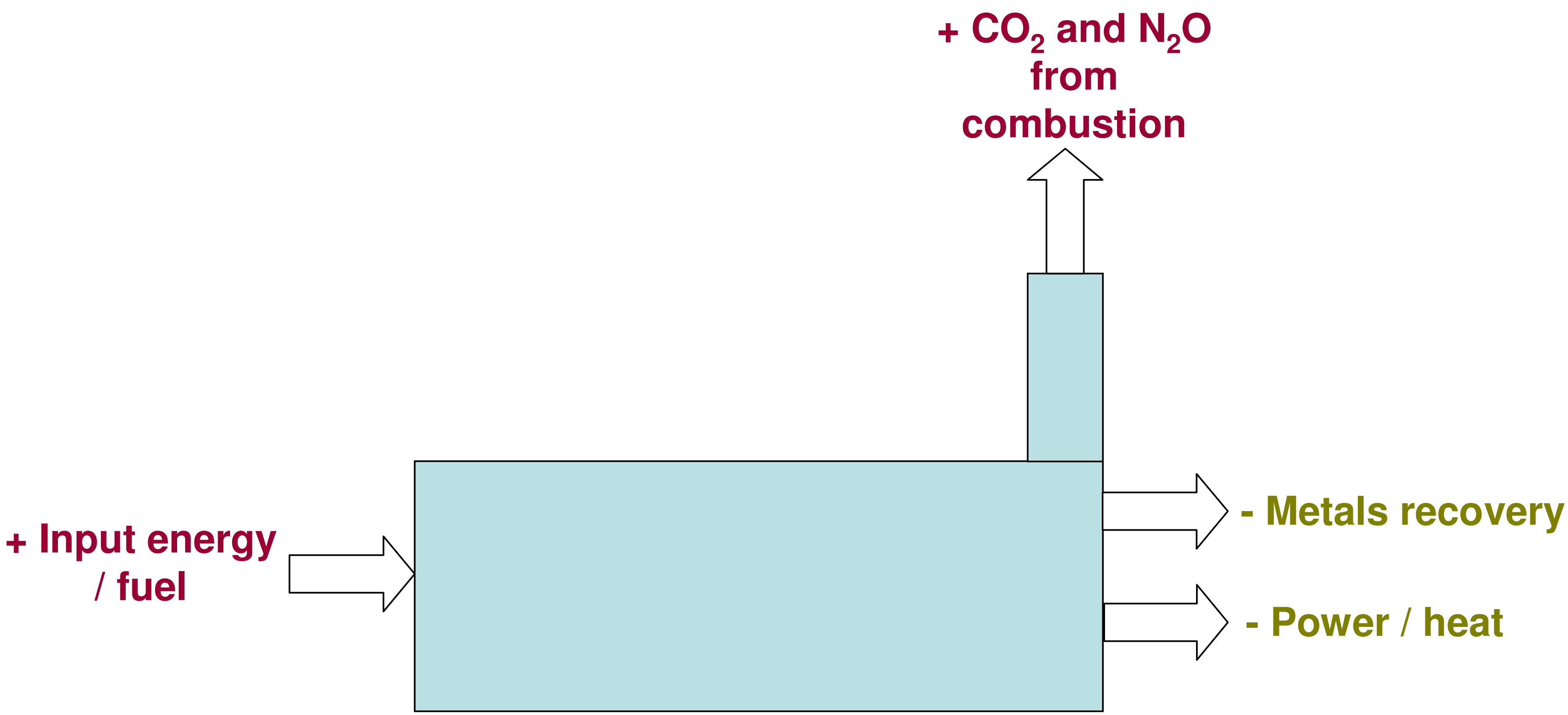
GHG Balance Example – Incineration



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Cost-benefit Analysis and Discounting

- Informed by Life-cycle Assessment (LCA) principles

- Monetisation can facilitate consideration of GHG impacts in decision-making
  - Now ‘required’ by Defra for all Government Impact Assessments
  - Are more expensive technologies worth paying for?

- ‘Time’ is a critical factor
  - No arbitrary ‘cut-off’ date after 100 years
  - Incorporated through ‘discounting’ the value of future impacts
  - Benefits of delaying emissions are taken into consideration

- Broadly follows the approach in the Stern Review, but..
  - Based upon Defra-commissioned study on social costs of carbon (SCC)*
  - Use of HM Treasury Green Book ‘time-declining’ discount rates

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Inclusion of Non-fossil Carbon

- Debatable whether all non-fossil (or 'biogenic') emissions should be considered 'carbon neutral'
  - Difficult to differentiate between types of carbon in residual waste, so IPCC Inventory Guidelines class all as 'short-cycle'

- Negative net balances within LCA studies appear to show that producing more residual waste is 'good for climate change'

- The atmosphere doesn't differentiate between the types of carbon it must absorb

- Would carbon capture and storage (CCS) of non-fossil carbon not count towards emissions reductions?

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Key 'Generic' Assumptions

- 'Carbon intensity' of displaced electricity sources
  - Electricity consumption is (sadly) growing
  - The displaced source is thus the alternative (base-load) new-build
  - Predominantly CCGT according to planning applications submitted to BERR
  - Value used for current 'intensity' = 447g CO_2 / kWh generated
- 'Carbon intensity' and 'load factor' of displaced heat sources
  - Average mix is appropriate in this context - both domestic and industrial
  - Seasonality and day/night demand considered but also possibility of cooling
  - 50-60% load assumed
  - Value used for current 'intensity' = 134g CO_2 / kWh generated
- Emissions reductions resulting from materials recovery and reprocessing are mean values derived from 3 studies
  - Wenzel (2006) on behalf of WRAP
  - ERM (2006) on behalf of Defra
  - AEA Technology (2001) on behalf of DG Environment

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Results from Selected Scenarios

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Rank	Scenario Description	Net Externality (£s)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Rank	Scenario Description	Net Externality (£s)
1	MBT (AD and maturation) with output to landfill and export of biogas for conversion to H_2 for use in vehicles	4.48
2	Plasma gasification (following autoclaving and maturation of rejects) and export of syngas for conversion to H_2 for use in vehicles	4.83
3	MBT (AD and maturation) with output to landfill and export of biogas to H_2 fuel cell for stationery power generation (CHP)	5.25
4	Gasification (following autoclaving and maturation of rejects) and export of syngas for conversion to H_2 for use in vehicles	5.75
5	MBT (AD and maturation) with CHP and output to landfill	6.01
6	Gasification (following MBT biodrying and maturation of rejects) using a gas engine (CHP)	9.01
7	MBT (biostabilisation) with output sent to landfill (in ‘stabilised’ cell)	9.55
8	Incineration (with CHP)	10.21
9	Incineration (with electricity only)	11.45
10	Landfill (with electricity only)	31.90

Sensitivity Analysis

- Core objective is to provide a ranking of scenarios
  - Not an attempt to model every possible range of variables
  - Central assumptions in Atropos© based upon ongoing review of publications and wide personal communications
- ‘Monte Carlo’ analysis will be useful in follow-up study
  - Ability to model random ‘samples’ of estimated ranges of key variables
- Range of ‘sensitivities’ tested within study
  - Modelling of a ‘typical’ LCA approach represents key test
- Order of magnitude of change in rankings is insignificant

Rank	Scenario Description	Net Emissions (kg/CO_2 eq)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Rank	Scenario Description	Net Emissions (kg/CO_2 eq)
1	Plasma gasification (following autoclaving and maturation of rejects) and export of syngas for conversion to H_2 for use in vehicles	-413.26
2	MBT (AD and maturation) with output to landfill and export of biogas for conversion to H_2 for use in vehicles	-365.73
3	Gasification (following autoclaving and maturation of rejects) and export of syngas for conversion to H_2 for use in vehicles	-327.69
4	MBT (AD and maturation) with output to landfill and export of biogas to H_2 fuel cell for stationery power generation (CHP)	-297.29
5	MBT (AD and maturation) with CHP and output to landfill	-281.42
6	Gasification (following MBT biodrying and maturation of rejects) using a gas engine (CHP)	-206.28
7	MBT (biostabilisation) with output sent to landfill (in ‘stabilised’ cell)	-93.28
8	Incineration (with CHP)	1.55
9	Incineration (with electricity only)	70.42
10	Landfill (with electricity only)	299.52

Key Conclusions and Implications

Conclusion	Related Recommendation

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Scenarios incorporating MBT (AD with maturation) perform most consistently well	Pending further analysis of risks, develop related cost / planning guidance for local authorities

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The best performing technology incorporating combustion lies 13th the rankings	Promote technologies which are not locked to energy generation using steam turbines

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The best performing technology incorporating combustion lies 13th the rankings	Promote technologies which are not locked to energy generation using steam turbines
If coupled with fuel cells, oxygen blown gasification performs better than air-blown gasification	Endorse oxygen-blown systems, whether coupled with 'conventional' or plasma gasification

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CHP delivers clear GHG benefits over electricity or heat only solutions	Encourage developers to select sites with potential for embedded generation

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CHP delivers clear GHG benefits over electricity or heat only solutions	Encourage developers to select sites with potential for embedded generation
Maximising net energy output does not result in the best GHG performance	These issues should not be overlooked by policy-makers in the pursuit of ‘renewable’ energy capacity
Recovering materials via residual waste treatment is important from a GHG perspective	

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